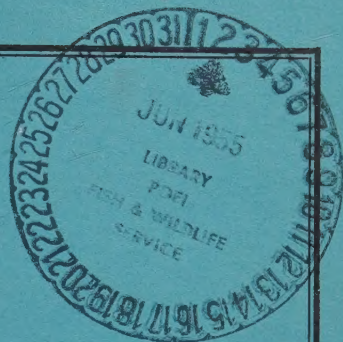




SCOTTISH HOME DEPARTMENT

Marine Research
1955 No. 2

Observations on the Recaptures of Tagged Lobsters in Scotland

By H. J. THOMAS, B.Sc., Ph.D.

EDINBURGH: HER MAJESTY'S STATIONERY OFFICE

1955

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Observations on the Recaptures of Tagged Lobsters in Scotland

INTRODUCTION

Tagging experiments have been used extensively in Canada in population studies of the American lobster (Wilder, 1947). The Canadian practice of restricting commercial fishing to a relatively short season—often of less than two months on any one ground—considerably facilitates this method of determining fishing mortality. In Britain there is no statutory restriction of the fishing season but, despite certain limitations, tagging experiments afford the most reliable means of estimating the level of fishing mortality in a lobster stock, which is an essential datum for rationalisation of the fishery.

Lobster fishing is of considerable importance over large areas of the Scottish coast. In view of this and of the revision in the legislation governing the landing of lobsters in Britain, which came into force in 1951, special tagging experiments were carried out from the Marine Laboratory, Aberdeen. Sincere thanks are due to the Fishery Officers of the Scottish Home Department, in the districts concerned, and to many fishermen, for their unstinted co-operation.

METHODS

The length analysis and composition of lobster stocks around Scotland suggest that the most intensive fishery obtains off the south-east coast, whilst exploitation around the Orkney Islands and off the west coast is considerably less (Thomas, 1951). These three areas were selected for a series of tagging experiments which commenced in Berwickshire (south-east Scotland) in 1950 and were repeated in the same area during 1951. In 1952, experiments were carried out off the Scottish west coast, and in 1953 around the Orkney Islands.

One of the limitations of tagging lobsters is that tags are lost at moulting. The peak season of moulting in Scottish waters is around July. Tagging experiments have therefore, in every case, been completed about September, by which time the vast majority of lobsters will have cast. Only the period from liberation until the following June has been used in the calculation of fishing mortalities. A proportion of lobsters of up to 10 inches overall length may cast more often than once per year. For this reason, very few were tagged which measured less than 10 inches. This precaution was particularly necessary in the experiments off the Berwickshire coast, where the greater proportion of the catch normally consists of lobsters below this length. As an added precaution, non-berried female lobsters were preferred, since these might be expected to remain without casting for the ensuing two seasons. Usually, only lobsters of between $10\frac{1}{2}$ and $11\frac{1}{2}$ inches should be used in order to minimize, as far as is compatible with other prerequisites, the effects of creel selectivity (Thomas, 1953). This standard was generally adhered to and was relaxed only in certain cases in order to obtain the required numbers.

Lobsters were purchased locally in the areas of the experiments, except that in the 1951 investigations half of the lobsters originated in Orkney and were liberated with local-caught Berwickshire lobsters in equal numbers at each station. In September, 1950, 480 local-caught lobsters were tagged and released at stations along the south-east Scottish coast from Emmanuel Head to Dunbar (Fig. 1). In October, 1951, a total of 460 tagged lobsters were set free over the fishing grounds from Emmanuel Head to St. Abbs Head. For the experiments carried out on the west of Scotland in August, 1952, 250 tagged lobsters were liberated on the west coast of Mull, 250 on the south and west coasts of Skye and 400 on the east side of the Outer Hebrides south from Benbecula. In September, 1953, 1,065 tagged lobsters were released at stations covering practically the whole coastline of the Orkney Islands (Fig. 1). In all experiments stations were spaced at intervals of about 1 mile, except that lobsters were liberated only off rocky coasts or on known lobster grounds. Lobsters were set free in batches of ten, in all cases except at Orkney, where the number was reduced to five per station in order to obtain an increased average.

The fishery in the south-east of Scotland is mixed lobster and crab, and is carried on mainly by boats of about 35 ft. overall length which work throughout the year and operate in depths up to about 30 fathoms. In this area, therefore, stations were arranged to cover the grounds at depths between 7 and 23 fathoms. Off the west coast and in Orkney, on the other hand, fishing is mainly by boats of 25 ft. or less, and is confined to the shallow, immediate coastal fringe. In these areas, therefore, liberations were confined to depths of between 4 and 7 fathoms.

The type of tag used, method of fixing, procedure for return, rewards, etc., are given on page 27 of "A guide to fish marks" (Anon., 1953).

Recruitment to the stocks of marketable lobsters occurs at casting, mainly centred in or near July. In estimating the annual fishing mortality, the year has therefore been taken as commencing on 1st July.

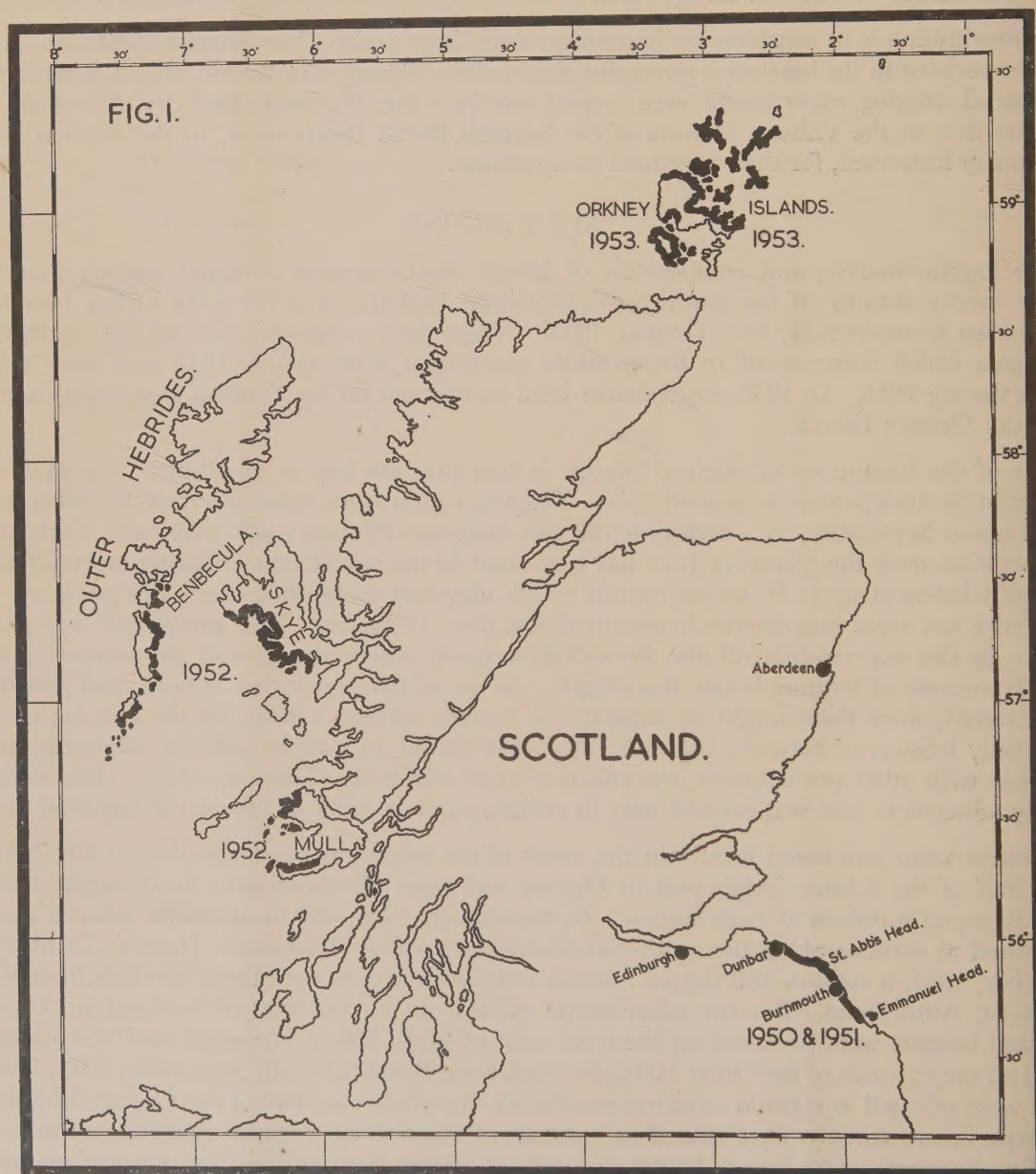


Fig. 1 Areas covered by lobster tagging experiments during the years 1950-54. The year of release for each area is shown.

extending to the 30th of June in the following year. Details of the monthly landings of lobsters in creek over the areas of the experiments were supplied by the Fishery Officers of the Scottish Home Department. The annual fishing mortality has been calculated by multiplying the ratio of the return of tagged lobsters to liberations, over the period from the initiation of the experiment to the succeeding June, by the ratio of the annual catch of lobsters to that for the period of the experiment.

During 1950, a commercial fisherman at Burnmouth was employed to measure his catch throughout the year. Lobsters were measured to the nearest quarter of an inch, from the tip of the rostrum to the tip of the telson, with the tail extended. During 1951 and 1952 similar experiments were carried out at Burnmouth in May and September. On the west coast a commercial sample of lobsters was measured in August, 1952. In Orkney a series of commercial samples, from various areas around the islands, were measured during September, 1953. Since the length distribution of the males gives a more readily interpreted indication of the level of *overall* mortality (Thomas, 1955), it is given for comparison with tagging results in each area.



FIG. 2.

Positions at which tagged lobsters were liberated and the numbers of recaptures off the south-east of Scotland from the 1950 and 1951 experiments respectively. Each figure represents the number of returns out of ten tagged lobsters released. Figures not enclosed denote the 1950 experiments. Enclosed figures refer to the 1951 releases. Enclosure by a circle distinguishes releases of lobsters of Orkney origin from those of local origin denoted by enclosure within a square.

RECAPTURES

(a) BURNMOUTH

Figure 2 shows the stations at which tagged lobsters were released during both the 1950-51 and 1951-52 experiments, together with the numbers of returns. The area southward from Burnmouth to Emmanuel Head is fished by boats from the former creek. It will be seen that tags were recovered from all stations in this area, which is extensively and relatively uniformly exploited. The annual fishing mortality on these grounds, as calculated from the returned tags, was about 51% in the 1950-51 season and 47% during 1951-52 (Table 1).

TABLE I

Percentage annual fishing mortality on the grounds fished from Burnmouth creek during the seasons 1950-51 and 1951-52.

		1950-51	1951-52
Number of lobsters caught July 1st to June 30th	..	63,863	54,160
Number caught during the tagging period	..	40,753	28,790
Number of tagged lobsters released over the area	..	220	330
Number of tags recovered up to June 30th	..	72	85
Annual fishing mortality rate and standard error	..	51%±5%	47%±4½%

The length distribution of male lobsters in the seasons 1950-51 and 1951-52 is shown in Fig. 3. This suggests an *overall* annual mortality of about 70% to 75%. This estimate can, however, be only approximate (Thomas, 1951).

FIG. 3.

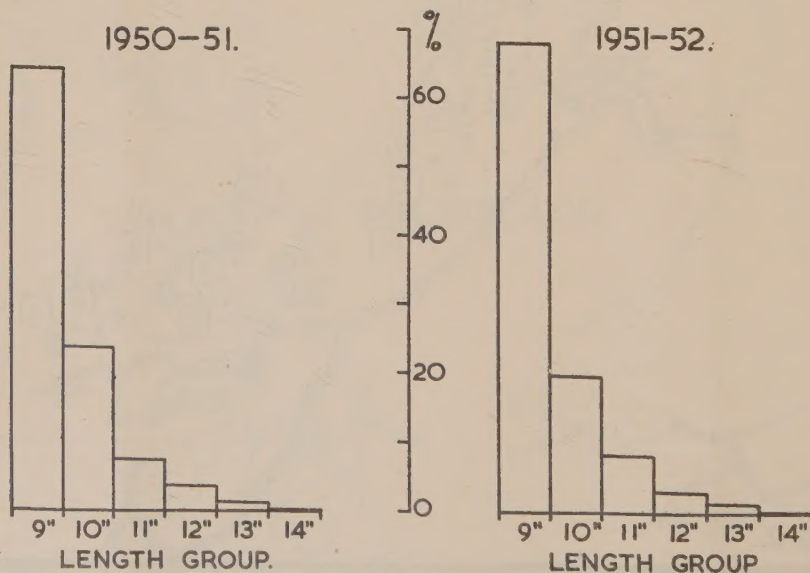


Fig. 3 Length distribution amongst male lobsters, by one inch length groups, each expressed as a percentage of the total number of males of overall length 9 inches and above, at Burnmouth: A—During the season 1950-51; B—During the season 1951-52.

TABLE II

Percentage recaptures within stated radii of the points of release and average period of liberty. The data relate to lobster tagging experiments at Burnmouth in 1950 and 1951 combined.

Distance travelled in miles	Less than 1	1—2	2—3	3—4	4—5	5—6	6—7	7—8	8—9	9 and over
Percentage recaptures	31.7	32.2	13.6	6.3	5.9	3.4	2.0	2.0	1.0	2.0
Average days free	137	146	138	131	135	84	195	—	—	—

The majority of lobsters are recaptured within a few miles of the point of release (Table 2). The distance travelled is not noticeably related to the period of liberty. The average distance travelled in two sets of experiments was only 2.2 miles and 1.8 miles, respectively. The average residual alongshore movement was only 0.8 and 0.1 mile, respectively, northward. In the latter case the movement of lobsters originating in Orkney showed no difference from that of lobsters which were of local origin.

The percentage recaptures amongst males and females up to the 30th June of the year following liberation was not markedly different, being 26% and 23%, respectively. There was some tendency for lobsters liberated in deeper water to show a slightly lower percentage recapture and a somewhat longer period of liberty, suggesting that a greater fishing effort is applied to the shallower water fishery (Table 3).

TABLE III

Relationship between depth of release, percentage recaptures and average days free in lobsters tagged at Burnmouth, 1950 and 1951.

Depth of release	7-10 fm.	11-15 fm.	18-23 fm.	Overall
Percentage recaptures	35.3	31.7	30.6	32.3
Average days free	46.7	48.3	51.6	48.9

WEST COAST

Tagging experiments on the Scottish west coast extended over grounds off the west of Mull, the west of Skye and the east of the Outer Hebrides south from Benbecula (Fig. 1). The stations at which lobsters were liberated, and the numbers recaptured, are shown in Fig. 4. Exploitation on the west coast, like that on fishing grounds off the south-east of Scotland, is very localised. Fishing is undertaken primarily by crofters, who work small craft and do not often fish more than five miles from their anchorages.

Crofting communities are widely spaced and, in consequence, some sections of the coast are seldom, or never, fished. This is apparent in the proportion of returns. Recaptures from around Skye and Mull, for example, are low, but the proportion of returns from around the island of Soay to the south of Skye is relatively high (Fig. 4). The general low level of returns cannot be taken as implying that the grounds are not suitable for lobsters, for they have been worked successfully in certain former years. In the same way, the majority of returns from the Outer Hebrides derive from liberations off Benbecula and North Uist, although the more southerly grounds are probably equally suitable for lobsters. The localised nature of the fishery becomes still more marked if the west coast is considered as a whole. The exposed coasts, such as that to the west of the Outer Isles, where communities tend to be even more scattered and in sheltered areas, are still less fished.

The absence of any significant alongshore migration, observed on the south-east of Scotland, is confirmed by the recaptures from the west coast. In consequence, it is possible for a lobster population in a relatively restricted area to show characteristics of an intensively fished stock, whilst adjacent may be an extensive population showing the characteristics of a lightly fished stock. In circumstances such as

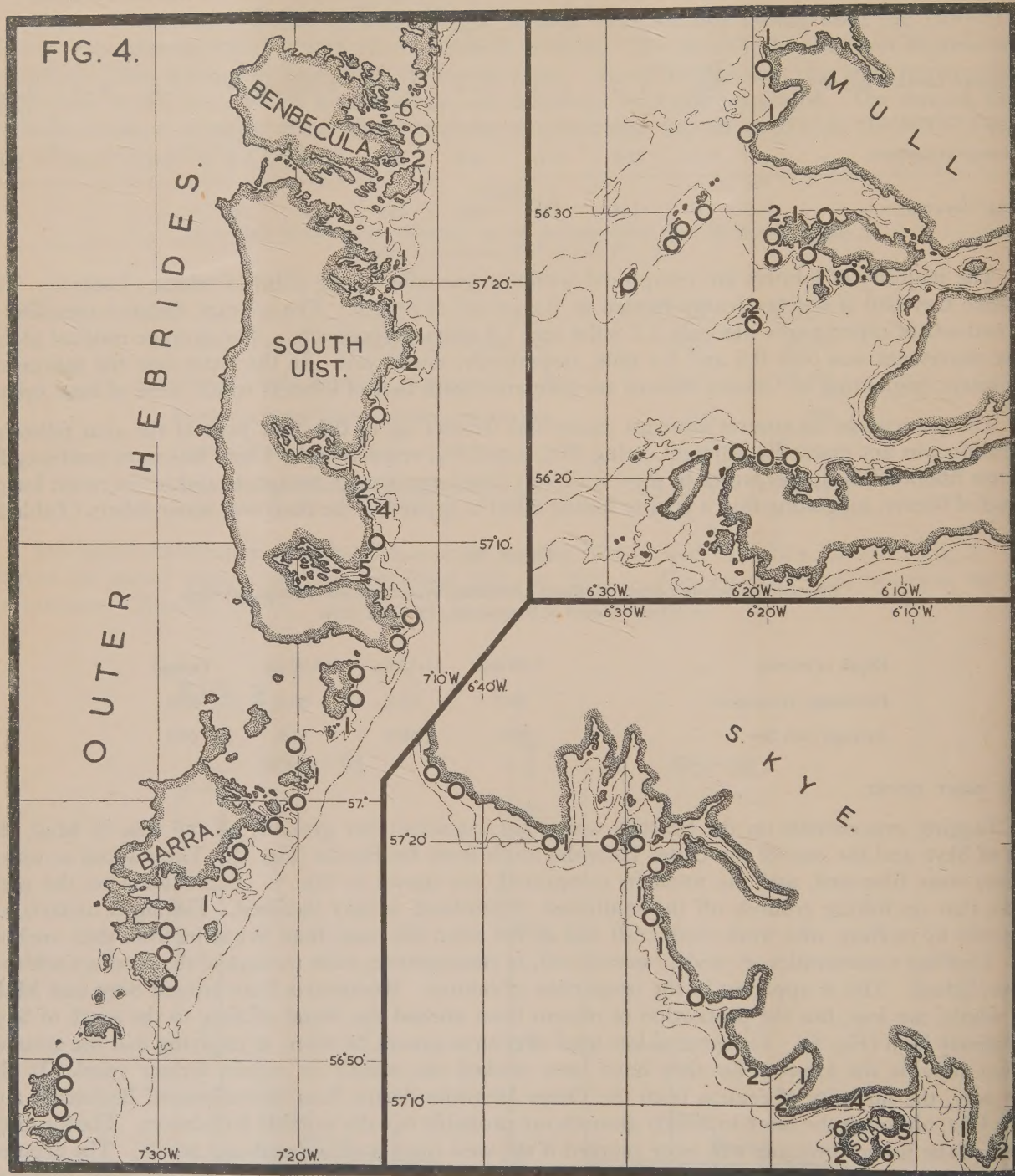


Fig. 4 Positions at which tagged lobsters were liberated and the numbers of recaptures in three areas of the Scottish west coast during 1952-53. Each figure represents the number of returns from ten tagged lobsters released.

these, the annual fishing mortality for the area as a whole does not adequately depict the situation. The annual fishing mortality works out at about 15% for the combined tagging returns from the west of Scotland; about 30% for the area around Soay (32 recaptures out of 110 releases); about 27% for the east of Benbecula and North Uist; and about 15% for the east coast of the southern half of the Outer Hebrides as a whole. The results indicate that large areas of the west coast are relatively unexploited, though it is not likely that the crofter with his small craft and special way of life can materially benefit from this situation. The low level of *overall* mortality is shown also by the length distribution (Fig. 5).

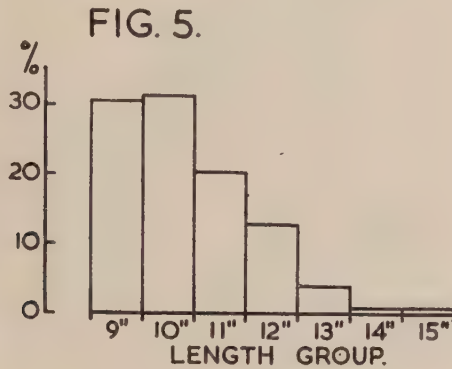


Fig. 5 Length distribution amongst male lobsters, by one inch length groups, each expressed as a percentage of the total number of males of overall length 9 inches and above at North Uist, Outer Hebrides, during August, 1952.

(c) ORKNEY

Figure 6 shows the release stations and the number of lobsters recaptured around the Orkney Islands. Local variability in the fishing effort, as described for the west coast, is typical of this area also. The experiments here covered almost the entire coast, and the results may therefore be taken as reasonably representative of the area as a whole, although particular districts within the area may differ widely in the amount of fishing. Returns indicate an annual fishing mortality of about 16%. This will very much underestimate the mortality in sheltered areas, such as east of Hoy and Westray, but will tend to overestimate the fishing on the exposed westerly coasts (Fig. 6). The length distribution of lobsters (Fig. 7) indicates a moderate *overall* annual mortality of approximately 34%.

DISCUSSION

The type of tag employed throughout the present experiments is lost at moulting. In order to minimize the effect of this, tagging has been restricted to certain classes and sizes of lobsters and to certain seasons. This in itself may introduce some error into the calculations, since lobsters of over 11 inches tend to be less readily caught in the Scottish type creel (Thomas, 1953). Creel selectivity could also operate differently in respect of the sexes in larger lobsters, since the male possesses very much stouter claws than the female and might, in consequence, be expected to enter the creel less readily. These factors will operate to some extent and will result in the calculated level of fishing mortality being below true value. Notwithstanding the precautions taken with regard to season and the class of lobsters used in the experiments, some of the tagged lobsters will have cast during the ensuing ten months. The loss of tags from this cause, together with losses through shedding of a claw or increased mortality due to handling, etc., will also result in calculated fishing mortality being an underestimate.

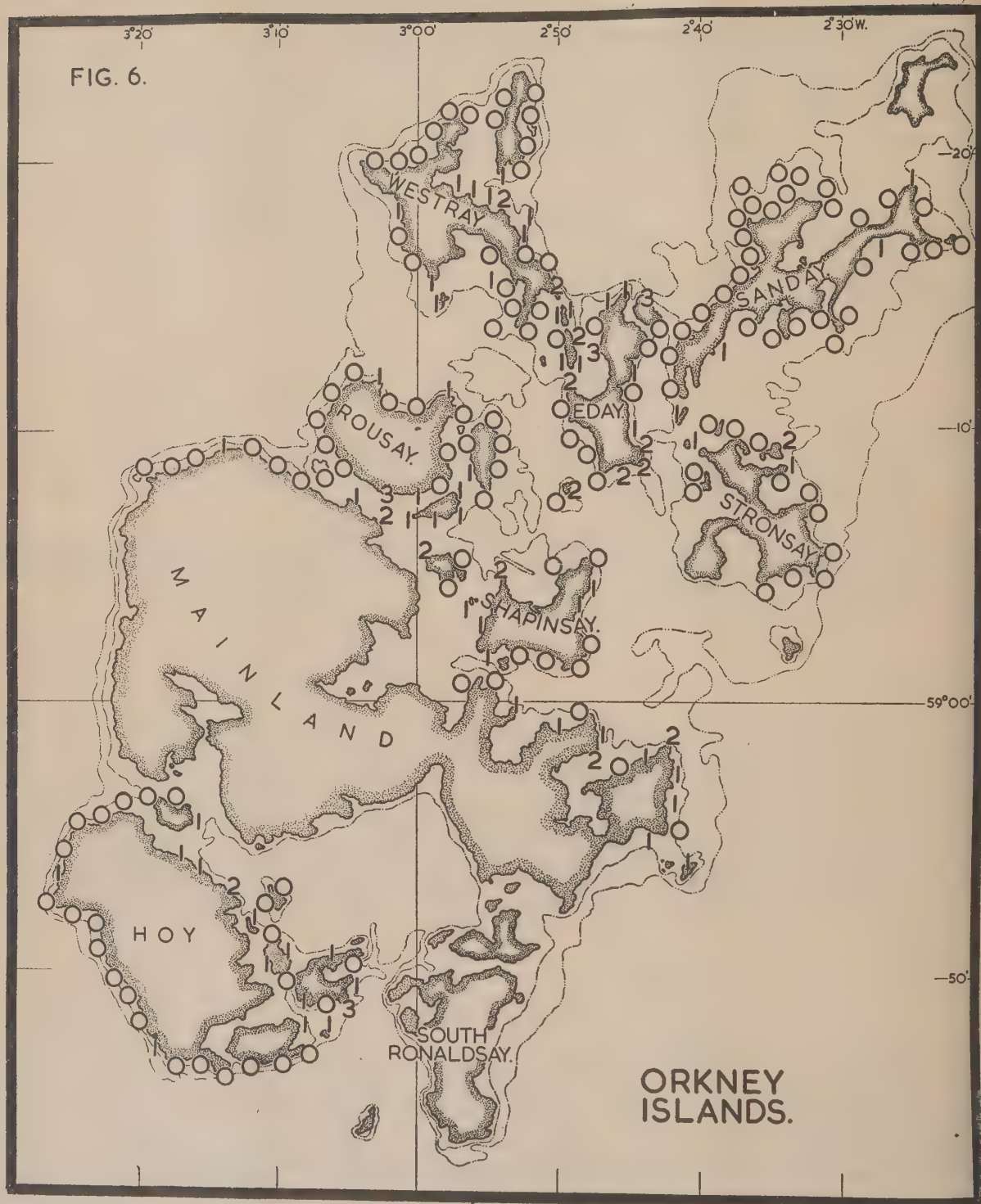


Fig. 6 Positions at which tagged lobsters were liberated and the numbers of recaptures around the Orkney Islands during 1953-54. Each figure represents the number of returns out of five tagged lobsters released.

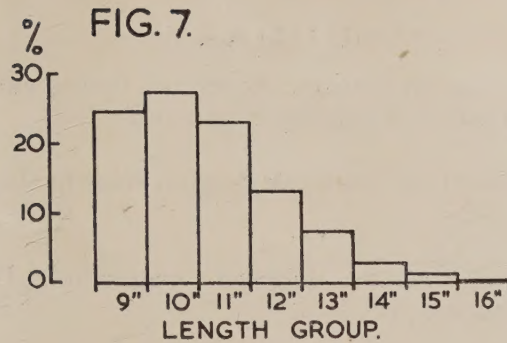


FIG. 7 Length distribution amongst male lobsters, by one inch length groups, each expressed as a percentage of the total number of males of overall length 9 inches and above from the Orkney islands during September, 1953.

All the available evidence suggests that lobsters do not normally undertake any extensive alongshore migration, and this factor can be neglected in considering the validity of mortality rates based on tagging returns. On the other hand, the marked stationary habit of the lobster itself introduces certain difficulties. Except where grounds are extensively worked, as at Burnmouth, bias may be introduced due to uneven distribution of the tagged lobsters over the fished and unfished grounds. Furthermore, it is questionable which is of greater practical significance: the fishing mortality for an area as a whole, or the mortality in the local, more regularly fished districts. In this connection, it is necessary to avoid, as far as possible, releasing lobsters on grounds which do not naturally support a population of average density. Difficulties in obtaining adequate recaptures do not arise in areas of intensive fishery but do arise where only moderate effort is applied, e.g. off the Scottish west coast and Orkney.

The depth of releases may also affect returns. This was seen to have a slight significance at Burnmouth, but it could almost certainly have an important effect in less extensively fished areas. In the present experiments on the west coast and off Orkney, tagged lobsters were released in depths of from 10 to 7 fathoms, in general covering the grounds fished. The lobsters, however, in the deeper waters outside this belt are a part of the available stock, and as a result problems arise similar to those occasioned by unequal fishing, as discussed above. In the present experiments this difficulty was mitigated, around the west coast and Orkney, by the steep shelf which is characteristic of much of the coastline on the grounds investigated (Figs. 4 and 6).

The majority of factors operate to make the estimate of fishing mortality from tagging experiments underestimate. Any recruitment to the stock of marketable sized lobsters which occurs during the period of the experiment will operate with the opposite effect. The design of the present experiments, however, should minimize this latter effect. The rough estimate of overall annual mortality, based on the length distribution of the male lobsters, in all cases exceeds, as it should, that shown for the fishing mortality as given by tagging results. Wilder (1947) suggests that in Canada the proportion of marketable sized lobsters which die through natural causes is small as compared with those which are caught. This may well be so in the Canadian fisheries, which are very intensive. It could also apply in the fishery off the south-east of Scotland. Natural mortality, however, must be proportionately of greater significance on the relatively lightly fished grounds of the Scottish west coast.

Having regard to all considerations, mortality rates calculated from tagging experiments can be regarded as reasonably consistent with those calculated from length distribution.

SUMMARY

1. A design for tagging experiments to estimate the annual fishing mortality, particularly in regard to length and class of lobster and season of tagging, is described.
2. The annual fishing mortalities off the south-east Scottish coast in the seasons 1950-51 and 1951-52 were about 50%.
3. Lobsters do not undertake any extensive alongshore migrations. The average distance travelled was about two miles. Movements are very local.
4. Returns of tags suggest an overall annual fishing mortality of about 15% for the areas investigated off the Scottish west coast and of about 16% around Orkney.
5. In areas of limited fishing intensity, the marked non-migratory habits of the lobster may result in wide local differences in mortality within relatively small areas.

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